A novel approach towards skill-based search and services of Open Educational Resources

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Abstract. Open educational resources (OER) have a high potential to address the growing need for training materials in management education and training. Today, a high number of OER in management are already available in a large number of repositories. However, users face barriers as they have to search repository by repository with different interfaces to retrieve the appropriate learning content. In addition, the use of search criteria related to skills, such as learning objectives and skill-levels is not generally supported. The European co-funded project OpenScout addresses these barriers by intelligently connecting leading European OER repositories and providing federated, skill-based search and retrieval web services. On top of this content federation the project supports users with easy-to-apply tools that will accelerate the (re-) use of open content.

Keywords: open educational resources, content reuse, competences, federated search, management education

1 Introduction

Management is a large education and training business field in Europe. Training topics range from general management and leadership to very specific issues like IT-Governance in the banking industry. Many enterprises, especially small and medium sized enterprises (SME), lack the financial resources and necessary flexibility to meet specific training needs of their employees. Therefore, the flexible access to a large amount of open learning resources can foster self-directed competence development much better and faster than formal courses and study programs. The term "Open Content" refers to online accessible digital assets (texts, images, graphics or multimedia) that are published under a licence that explicitly allows an end-user to access, copy, modify or redistribute the content with no or minimum costs [1]. In educational contexts, the term Open Educational Resources (OER) is often used and denotes digital objects (courses, course materials, modules, textbooks, videos, tests, simulations, tools etc.) which can be freely used, adapted, and distributed amongst interested stakeholders [2]. As it can expand access to learning and bridge the gap of formal and informal learning OER is of interest for both educational learning and corporate training.

There is already a large amount of OER on management topics available in learning object repositories (LOR). However, most business education organizations and SMEs do not use these contents or integrate them into their technical solutions (e.g. Learning Content Management Systems) [3]. Therefore, end-users face barriers when utilizing the content for learning in management. They have to search repository by repository with heterogeneous interfaces and different content categorization in order to retrieve the relevant content. Additionally, SMEs need approaches to training which match the existing and required staff competencies to solve ad-hoc problems. But the usage of search criteria related to competences and skills, such as learning objectives or competence-level is generally not supported by open repositories. Moreover, the systems do not support users with easy-to-apply tools and mechanisms that enable reuse, adaptation and internationalization of the content. Within the OpenScout project[1] these barriers are addressed.

OpenScout is an EU co-funded project which aims at providing skill-and-competence based search and retrieval web services that enable users to easily find, access, use and exchange open content for management education and training. The project not only connects leading European OER repositories but integrates its search services into existing learning suites like CLIX[2] and LearneXact[3], social networks and personal portals, to enable access from environments familiar to a wide range of users. The paper is organized as follow. In chapter 2, we describe the OpenScout system focusing on the interfaces and the infrastructure. In chapter 3 we will discuss the OpenScout application profile. This includes the competence based approach and

[1] www.openscout.net
[2] http://www.im-c.de/en/products/learning-management-system/product-overview/what-is-clix/
[3] http://www.learnexact.com/

the cultural classification for supporting the reuse with context and cultural specific information. Finally, we conclude and give an outlook of future work in chapter 4.

2 OpenScout System

2.1 User Interfaces

OpenScout Portal. The OpenScout web portal provides to end users all services and tools employed in the project from a single access point. Users can access open content and can use integrated tools (authoring tools as well as tools for communication and collaboration) which enable them to adapt and localize materials to their needs. Moreover, users have access to social network functionalities as well as to data social actions and annotations like tagging, rating, and commenting.

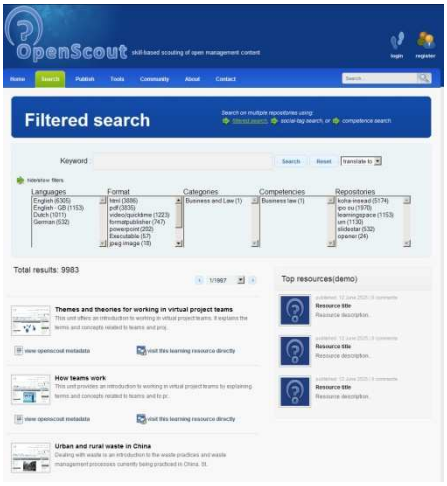

Fig. 1: OpenScout keyword search interface

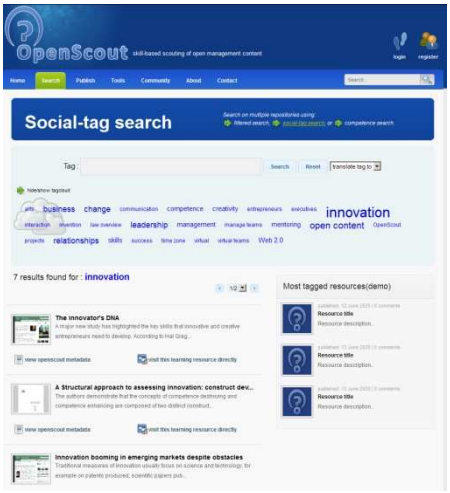

Fig. 2: OpenScout tag search interface

For supporting the learner while searching for the most suitable learning objects (LO), OpenScout offers a facetted search (see Fig. 1) and social or tag-based search (see Fig. 2) in addition to the general keyword search. The facetted search functionality allows the user to filter the search results according to the properties of the retrieved LOs, e.g. content type, competences, language, and repository. In the result list, all retrieved LOs are briefly described with their title, the beginning of their description as well as their URL and accompanied by a screenshot.

Users can choose to directly access a resource by clicking on the link or to first experience more information about it. In the detailed object view (see Fig. 3), users are presented with general information about the LO, such as its description(s) and learning resource type(s) as well as its social metadata (tags, comments, rating) and users can add social metadata if they are logged in. The users are also enabled to recommend learning resources by sharing them to popular social networks such as Facebook, LinkedIn and Twitter and hence increase the popularity of these resources

and of the portal as a whole. Furthermore, registered users can interact with the OpenScout community: see their friends, their added tags, their interests and their recommendations.

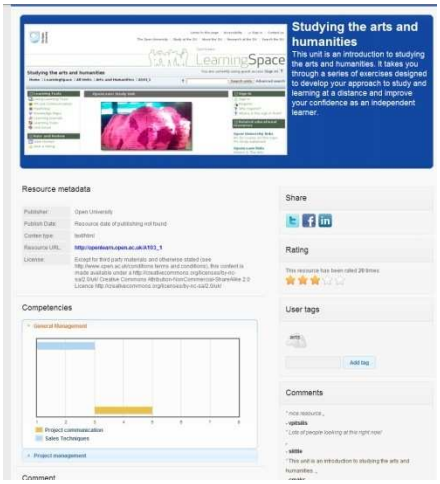

Fig. 3: OpenScout learning resource presentation

OpenScout Widget(s). In addition to web portal access, the OpenScout system also aims to offer widgets that can be embedded in external systems like Social Networks, Learning Management Systems or other platforms. Currently, OpenScout offers a web-based search Widget, which allows a user to directly search from familiar learning environment.

The Widgets offers a search-relevant subset of the above listed portal services in a condensed way. The functionalities include search for content, check content metadata details, access the query results by clicking direct links or recommend and share learning resources to friends in existing social networks. Moreover, the Widget isn't limited to the OpenScout content federation but allows for optionally searching in other databases such as YouTube, Slideshare or Wikipedia. The system calculates a ranking of the search results of all repositories to support users in selecting relevant resources. Users not only have the option to select the repositories to search in, but to restrict the search results to certain content types or languages, choose to search in all fields, or just in the author or tag fields. Finally the Widget code supports localization of the interface language to different languages (currently German and English are instantiated).

The currently available Widget is already integrated into the Learning Management Systems CLIX and eXact LMS, and into the personal portal iGoogle. It can be integrated into any other OpenSocial[4] compatible container, or can be embedded through an iFrame into any Web page. Integrating OpenScout through Widgets in existing applications will not only achieve a wide distribution and sustainable use of its services but also accelerate the (re-)use of open content massively.

[4] http://www.opensocial.org/

2.2 Infrastructure

The OpenScout system copies metadata describing learning resources that are stored in several learning object repositories (LOR) into the central OpenScout Repository Federation. The harvesting approach was preferred over direct search for performance and reliability reasons [4]. To enable the harvesting, an increasing number of repositories provide access to their metadata instances by offering an OAI-PMH [5] target. So far, the OpenScout system integrates the repositories OpenLearn[5], OpenER[6], SlideStar[7] and INSEAD[8] amongst others. The OpenScout Repository Federation offers an OAI-PMH target as well, to enable the content providers to re-harvest enriched metadata instances of their learning resources.

Furthermore, learning resources can be uploaded by OpenScout users. These include learning resources that are modifications or aggregations of resources that are already described through metadata stored in the OpenScout Repository Federation, but also independent learning resources. A Simple Publishing Interface (SPI) [6] is used to publish the learning resources and the respective metadata in the OpenScout Content Repository.

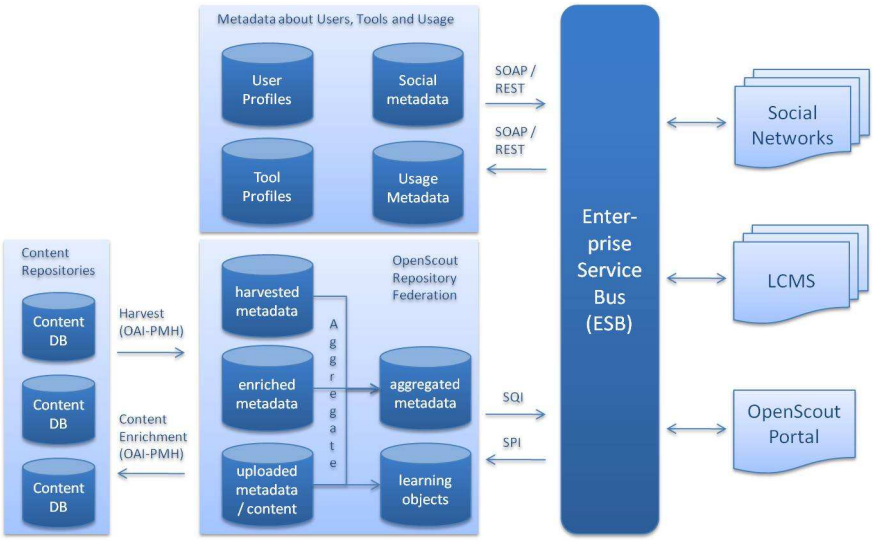

Fig. 4: The OpenScout architecture**.**

Once stored in the OpenScout Repository Federation, the learning resources are available online using an Apache web server[9] while the metadata instances are

[5] http://openlearn.open.ac.uk
[6]http://www.opener.ou.nl
[7]http://slidestar.de
[8]http://www.insead.edu
[9]http://httpd.apache.org/

indexed using Apache Lucene[10] to enable fast queries. The stored and indexed metadata instances can be queried through a Simple Query Interface (SQI) [7] which provides interoperability between search applications and LORs as it is neutral in terms of query languages and result formats. Currently, the OpenScout system allows Lucene, PLQL [8] level 0 and PLQL level 1 queries. As query result, statistics about the LOs, that match the query, can be returned to enable facetted search or the metadata instances are returned directly. The first one is enabled using SOLR[11] which is a search server based on Lucene.

OpenScout also maintains user profiles (containing information about the users, e.g. interests and competences), tool profiles (containing data about tools that can be recommended for adapting learning resources), social metadata (data added by users, e.g. tags and ratings), and usage metadata (data about the user's actions and the usage of objects). This data is stored in separate databases and is accessible through REST and / or SOAP services.

Since the OpenScout user interfaces (e.g. the web portal) need to access and combine data from different sources, the backend layer has to allow scalability, and an easy way to extend services with a plug-in based architecture without affecting the client layer. In order to address these issues, the enterprise service bus (ESB) technology, namely the open source ESB Apache ServiceMix[12] is used. This means, all service communication takes place via the ESB. Furthermore, whenever an event occurs (e.g. a user conducts a search or opens a document), the ESB calls a web service that stores the event as CAM (Contextualized Attention Metadata) [9] instance in the usage metadata database to enable further services (e.g. for recommending LOs).

3 OpenScout Application Profile

The IEEE Learning Object Metadata (LOM) standard is a metadata standard to describe educational resources. Its purpose is to facilitate search, acquisition, use and exchange of learning objects by creating a standardized way to describe learning resources while taking into account the diversity of contexts in which the learning objects and their metadata are reused[13]. A metadata instance comprises information about the LO that is grouped in nine categories: general, life cycle, meta-metadata, educational, technical, educational, rights, relations, annotation, and classification categories. In contrast to the LOM standard, where all data elements are optional, the OpenScout application profile (AP) defines some mandatory and recommended data elements to enable the functionalities the project aims for. However, the set of mandatory elements was kept small so that further repositories can be more easily integrated[14]. In the following, we describe how we adapted and extended the LOM

[10]http://lucene.apache.org/
[11]http://lucene.apache.org/solr/
[12] http://servicemix.apache.org/home.html
[13] http://ltsc.ieee.org/wg12/20020612-Final-LOM-Draft.html
[14] For further details see D1.1 Analysis Report on Federated Infrastructure and Application Profile available at http://www.openscout.net/downloads/deliverables

standard to enable skill- and competence based search as well as re-use, adaption and localizing of existing learning materials to the needs and contexts of learners and teachers.

3.1 Cultural Classification

OpenScout aims to support stakeholders in management education to re-use, adapt and localize existing learning materials to their own needs and context. One part of the solution is to provide a set of integrated tools and support mechanisms (best practices and user guides) [10]. Additionally OpenScout wants to support the re-use and adaptation by storing and presenting cultural and context specific information regarding the learning resources. This is done by the means of the cultural specification which we discuss in this paper.

In recent literature on OER, there have been several indications of challenges towards utilization of OER in different contexts. Deimann et al. [11] argue that OER should provide context information and give indications where the material fits. OER should be "culturally portable" and support users to evaluate if the information is suitable for their context [11]. The role of cultural specification of OpenScout is to support this portability of OER.

Development and provision of such a specification should take into account the end-users of OER and capture possible contexts the materials can be applied in. OpenScout organized an interview and a brainstorming session with domain experts ranging from members of Higher Education to Business Schools and SME clusters in order to capture requirements for the specification. The results were strengthened with relevant literature after accomplishing a basic set of requirements. Following insights could be captured regarding the specification:

- The specification should provide means for a registered end-user as well as for content providers to add information to the LOs that isn't included typically in the LOM
- Users should be able to add information to the LOs when accessing certain OER in OpenScout portal or when uploading material to the OpenScout repository
- The specification should support and explain clearly: **what type of learning material it is** (is it a full course, case study, presentation etc.), **where the material has been used / usage context** (including information on the type of domain, location and language), and **how the material was applied** (including information on learning style, the focus and roles of stakeholders).
- Specification should give users the option to point out adaptation needs that indicate how the material **could be adapted by others** (should indicate if the material is culture and context specific and if some parts are general in a sense that they might fit different domains and countries etc.)

The requirements were also emphasizing the need to build a comprehensive classification with clear attributes for each of the aspects. Additionally the application of OER sets its own requirements, since OER might be used not just in Higher Education and Business Schools but also on other levels of education and in

vocational training for SMEs and large enterprises etc. The cultural specification should take these aspects into consideration.

To get to this comprehensive classification with clear attributes, the brainstorming session mentioned above identified an initial list of important aspects which were necessary for the classification. Based on the initial list, a literature review focusing mainly on research in the fields of cultural differences and barriers of OER was conducted to build the first version of the cultural classification.

In the next step the Learning Object Metadata standard was analyzed in order to see to which extent the requirements for the cultural specification were covered. Several fields of the LOM standard were fitting to the categories of the cultural classification but the possible values were set too narrow. For other categories of the cultural classification no fitting field could be found. Therefore, we adjusted the OpenScout AP by extending the values of several entries and adding some additional entries to the AP. The first version of the cultural classification including the value extension and the AP integration and changes can be seen in (see Table 1). During the course of the project the presented cultural specification will be further developed.

Category	Source	Explanation	Value Extension	AP Integration
Language	Richter &Pawlowski [12], Expert Interviews	Language of the learning object		LOM 1.3
Learning Resource Type	Expert Interviews	Type of content	Presentation, Research Paper, Checklist, Course module, Full course, Video, Case Study, Modelling tools, Games, Serious games, Virtual worlds, Role-playing games, MUD	Extension of the value space of LOM 5.2
Usage Context	Expert Interviews	Intended context of usage of the learning object	Conference, Vocational Training – SME, Vocational Training – Large Company	Extension of the value space of LOM 5.6
Industry Sector	Expert Interviews	Industry sector covered by the learning object	Aerospace & Defence, Automobiles, Banking &Insurance, Chemicals, Construction & Building Materials, Electronic & Electrical Equipment, Energy & Oil & Gas, Engineering & Machinery, Forestry & Paper, Household Goods & Textiles, Information Technology, Leisure, Entertainment & Hotels, Media & Photography, Mining, Pharmaceuticals & Health, Real Estate, Retailing, Telecommunication Services, Transport,	Extension of the value space of LOM 9.1 and definition of a new classification that to be used for LOM 9.2
Region	Hofstede [13], Henderson [14], Richter	Intended region for the usage of the learning	According to Country ISO Char 3 Code	New field LOM 5.12

Category	Source	Explanation	Value Extension	AP Integration
	&Pawlowski [12]	resource		
Adaptation needs	Expert Interviews	Cultural and context specific adaptation needs identified for the learning resource	Free text field	Extension of the definition of LOM 8
Learning theory	Henderson [14]	Which learning theory does the learning resource belong to?	Behaviourist, Cognitivist, Constructivist	New field LOM 5.13
Focus	Henderson [14]	Abstraction level of the learning resource	Abstract, Concrete	New field LOM 5.14
Teacher / Learner Role	Henderson [14]	Relation between Teacher and Learner	Strict control, uncontrolled	New field LOM 5.15
Learning Strategy	Henderson [14]	Strategies expected from the learners	Individualism, Collectivism	New field LOM 5.16
Religion	Richter &Pawlowski [12]	Religious aspects influencing the learning resource	Free text field	Extension of the definition of LOM 1.6
History	Richter &Pawlowski [12]	Historical aspects influencing the learning resource	Free text field	LOM 1.6
Politics	Richter &Pawlowski [12]	Political aspects influencing the learning resource	Free text field	Extension of the definition of LOM 1.6

Table 1: Initial OpenScout Cultural Classification

As mentioned above, OpenScout follows a user driven approach to add these additional information to the existing LOs either at the time of publishing (uploading) or when accessing LOs in the OpenScout portal. Users are able to enrich the existing metadata of LOs with this information according to their personal impression.

The cultural specification will be used in different ways within the OpenScout System: Personal recommendations of LOs and support of adaptation processes. For personal recommendations the information provided by the cultural specification will be matched with information provided by the user profiles and with user actions. For adaptation of learning materials, the cultural specification can support the user to judge whether modifications are needed to fit the material to own context and whether specific challenges in the adaptation are pointed out through the specification.

3.2 Competences

The OpenScout projects implements a skill- and competence based search functionality for OER in the field of business and management education [15]. Taken the paradigm of lifelong learning, competence-based learning addresses directly the

need of individuals to upgrade their knowledge, skills and competence in a discipline throughout their lives as required for a lifelong competence development.

Competence-based approaches in the field of formal and/or non-formal education are becoming more common and offer the opportunity to develop flexible services that meet the needs of learners, trainers and potential employers. With the implementation of competence based education more tailored and personalized approaches are possible that allow very specific training and learning activities without the need to follow complete education programs. In order to support and use effectively this link between competence and education, there is also the need to provide reusable definitions of competences, across the different systems. To realize the competence-based search and browsing of OER in business and management education the project uses a competence service library that offers top-down and bottom-up metadata enrichment and support for individual competence development in the future [16]. The competence service library contains services for top-down implementation of a competence taxonomy and tagging services that allow to build bottom-up folksonomies.

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                <value>competency</value>
        </purpose>
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                </source>
                <taxon>
                        <id>Domain Identifier</id>
                        <entry>
                                <string language="en">Domain Title</string>
                        </entry>
                </taxon>
                <taxon>
                        <id>Competence Identifier</id>
                        <entry>
                                <string language="en">Competence Title</string>
                        </entry>
                        <mineqf>Minimum EQF Level</mineqf>
                        <maxeqf>Maximum EQF Level</maxeqf>
                </taxon>
        </taxonPath>
</classification>
```

Fig. 5: Competences in the application profile

The project consortium has produced a competence taxonomy that consists of competence categories and descriptions of competences in the domain. Learning resources in the OpenScout Repository Federation can be enriched with competences and levels according to the European Qualification Framework (EQF).

In compliance with the IEEE Standard for LOM, we store the metadata related to competencies for each LO in the classification section of the LOM (see Fig. 5). Each LO can have any number of competences associated to it. For each competence of a LO, the minimum and maximum proficiency scale values are included.

To collect, catalogue, manage, and maintain the competence metadata a toolset has been created. The core of the toolset is the competence catalogue that stores the competence taxonomy. It contains competence domains and their related competences as well as external resources, and a proficiency scale description based on EQF. For example, the competence domain “economics” comprises the competences “Being able to apply economic and business forecasting” and “Being able to conduct capital budgeting and investment decisions” amongst others.

Domain experts from the project consortium will enrich learning resources in the future with specific information about related competences and proficiency scales. Main target of the implementation is to support users with individual competence profiles to find learning resources that fit to their competence development goals.

4 Conclusion / Outlook

This paper describes technologies and strategies of the project OpenScout to make OER in the area of business and management education more accessible and appealing to learners. OpenScout not only focuses on a federated search, but stresses that open content can only be successful and sustainable if end-users collaboratively work on the resources. Therefore, OpenScout offers tools for re-use and adaptation and puts a strong focus on processes enabling users to localize existing learning materials to their own needs and context with a specific cultural specification of the material. By introducing a competence based approach to learning resources OpenScout supports effectively life-long learning of the individual learner in SMEs and training/education institutions

Currently, we work on fully integrating all components into the prototype. A competence tagging pilot is running where domain experts annotate federated learning resources according to competences. The integration of tools into the OpenScout portal is improved so that a resource specific recommendation of suitable tools can be provided. Furthermore, mechanisms for recommending tools and learning resources based on the users’ context are currently deployed using the collected usage data. The search Widget is re-designed and a tighter integration into existing Social Networks is implemented.

As part of a continuous evaluation the portal has been presented to target users from the management domain at various events and has received positive feedback and interest. In order to achieve a long term success OpenScout is continuously working on integrating additional management related repositories. Content providers collaborating with OpenScout not only have functional benefits (e.g. access to enriched metadata) but can also expect an increased visibility, international recognition and an innovative image within their community which in turn can increase enrolment to their professional offerings.

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